DPA-400
DPA-400 1.2

DisplayPort™ AUX Channel Monitor

User Manual

UNIGRAF

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Table of Contents

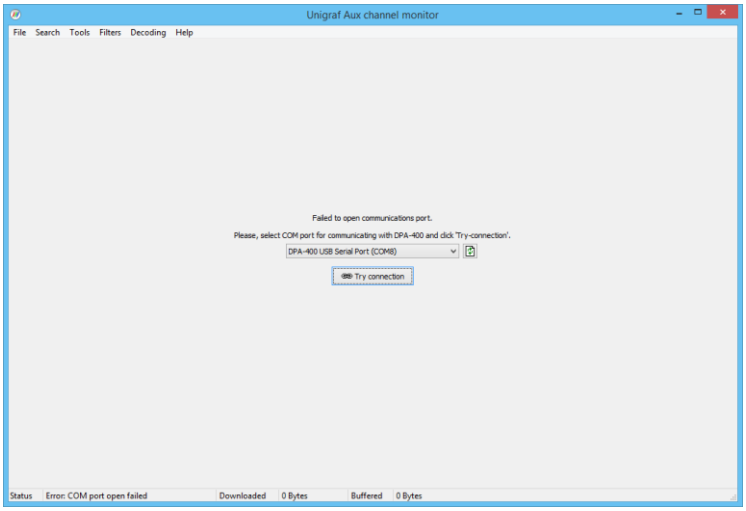
QUICK START Guide 4
1. ABOUT THIS MANUAL 5
2. GENERAL 6
Introducing the DPA-400 6
Functionality in a Nutshell 7
DisplayPort 1.2 Monitoring 8
3. SETUP INSTRUCTIONS 9
Contents of the Delivery 9
Product Setup 9
Installing the DPA-400 9
GUI Setup 10
Selecting the COM Port Used 10
Adding the License Key 11
DPA-400 Firmware Upgrade 12
4. DATA ACQUISITION 13
Getting Ready 13
The Main Window 14
Controlling the Acquisition 15
Starting and Stopping Data Acquisition 15
Monitored Signals 16
Acquiring Data 17
Decoding the Data 18
Inspecting the Acquired Data 18
Message Details 20
Filtering 21
Customizing the Main Window 22
Selecting Data Columns 22
Selecting Font and Colors 23
Coloring DPCD Address Ranges 23
Searching for Data 24
5. SAVING YOUR DATA 25
Saving to a Binary File 25
Creating a Test Report 25
Test Report Views 26
Appendix A: Specifications 28
General 28
Interfaces 28
Appendix B: I/O Connector 29
Appendix C: Advanced Filters 30

QUICK START GUIDE

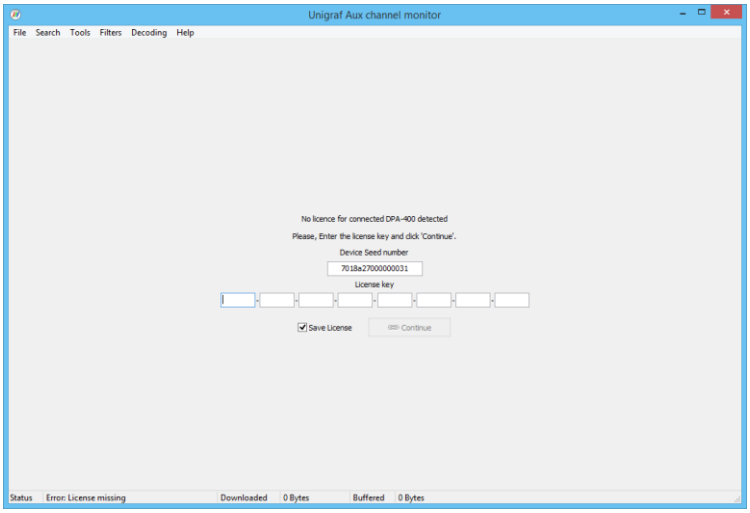
If you feel confident with installing new hardware and software in your PC you can attempt this simplified version of Unigraf DP AUX channel monitor (DPA-400) setup procedure

Serial Communication and License Key Setup

- Run the **DPA-400 Setup** installer
- Plug the USB connector of the DPA-400 to one of the USB ports in your PC.
- Launch the DPA-400 GUI (**DP_AuxMon.exe**)
- Indicate the DPA-400 unit in the combo-box and click **Try Connection**.


Unigraf Aux channel monitor
File Search Tools Filters Decoding Help
Failed to open communications port.
Please, select COM port for communicating with DPA-400 and click 'Try-connection'.
DPA-400 USB Serial Port (COM8)
Try connection
Status Error: COM port open failed
Downloaded 0 Bytes
Buffered 0 Bytes

- Insert the 32 character long *License Key* in the field provided and click **Continue**.



1. ABOUT THIS MANUAL

This manual introduces you to the installation and use of the Unigraf DP AUX Channel Monitor (DPA-400 1.2 and DPA-400). The purpose of this document is to:

- Provide instructions on how to install the provided software.
- Give an overview of the DPA-400 and of its features.
- Guide to the DPA-400 typical usage.

Product Versions

Functionality and operation described in this manual is related to DPA-400 1.2 and software release 1.3. Please contact Unigraf for details about other versions or refer to the version specific release notes.

Notes

On certain sections of this manual, when important information is given, text is formatted as follows. Please read these notes carefully.

Note	This text is an important note

2. GENERAL

Introducing the DPA-400

The Unigraf DP AUX Channel monitor is a compact, pocket sized device that provides a full DisplayPort™ AUX channel traffic analysis. DPA-400 and its Windows GUI tool enable the user to monitor, capture, parse and document all messages sent by DisplayPort™ source, sink or branch devices.

Each message is shown as time stamped raw data and also in its decoded form, expressed with the same terminology used by the DisplayPort™ standard specification. Also the activity of the Hot Plug Detect (HPD) signal and optionally other external signals is tracked and documented by a time stamp marking each of its changes of state.

The basic version of the product, DPA-400 is compliant with DP 1.1 while DPA-400 1.2 with the special pass-by cable is fully compatible with DP 1.2.

Easy to Use

The DPA-400 is a USB-powered device and measures only 10.5 x 13 x 3.5 centimeters, making it an ideal tool for a laboratory desktop and a snappy companion for a laptop computer.

DPA-400 preserves signal integrity by bypassing the Main Stream data lanes with the provided special cable. DPA-400 can be inserted between a sink and a source without needing any custom adapters or expensive pods.

Benefits

- Device independent
- Data documented with time stamps
- Pocket Size
- USB controlled and powered

Applications

- Tool in solving interoperability issues
- Essential partner with Link compliance testing
- Software debug and validation
- Documentation of functionality and protocol implementation
- Monitoring and time measurement of events

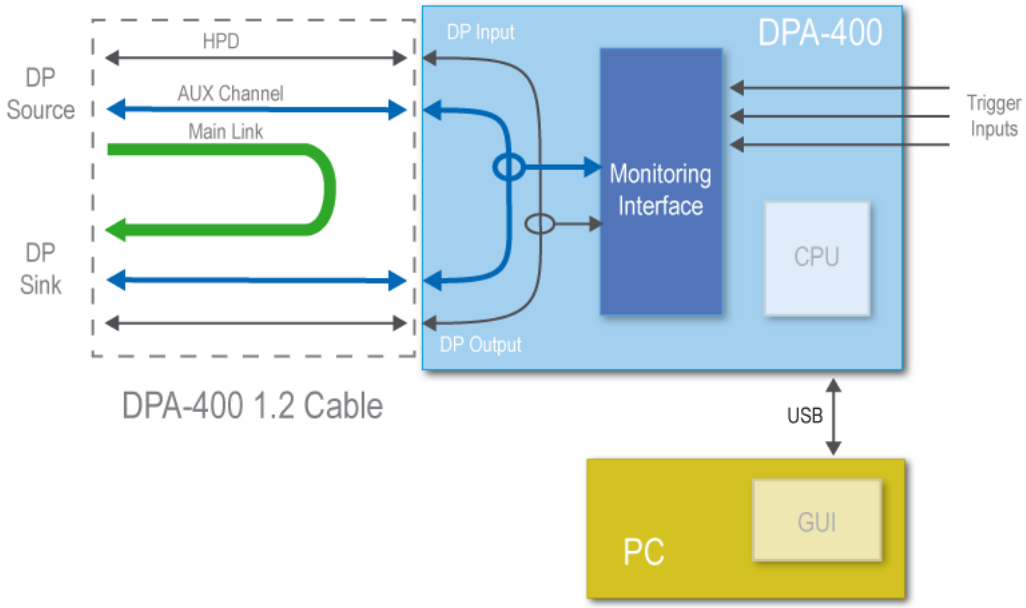
Functionality in a Nutshell

The DPA-400 is meant to be connected between a DisplayPort™ source and a DisplayPort™ sink device in order to detect and record the AUX channel communication between them. The DPA-400 does not take part to the communication but transparently monitors the AUX channel traffic, the HPD (Hot Plug Detect) line and three external digital inputs.

The user can select to start the acquisition manually or on a specific transition (rising edge or falling edge) of one or more of the external inputs or of HPD. The user can also terminate the acquisition manually or on a different transition of the same input signals.

When the acquisition is enabled, each AUX channel transaction detected is stored in the DPA-400 internal memory and marked by a timestamp, starting from the time instant the acquisition begun.

The user can also select one or more of the external input signals or the HPD for being monitored. Every logical state change of the monitored signals is recorded together with the timestamp of when it happened. This is very useful, for instance, to know when HPD gets asserted and how long time each HPD pulse issued has taken.



The GUI application is used to control the acquisition start and stop, to select the monitored signals and to browse through the acquired data in a user-friendly fashion. The DPA-400 features a large internal memory that can quickly collect a huge amount of data. The user can download the data stored in the DPA-400 memory to the GUI as soon as it gets acquired or can pause the download to first inspect the already visible data. The download can be paused and restarted any number of times or aborted if the acquired data is not of interest.

After the acquisition is stopped, the downloaded data can be saved in binary format or as a portable HTML report. In its binary form, the saved data can only be opened by the DPA-400 GUI while in HTML format it can be opened with any available HTML browser.

DisplayPort 1.2 Monitoring

For monitoring and interpreting DP 1.2 signals you will need DPA-400 1.2 GUI. The new DP 1.2 compatible GUI version is able to detect and parse the new DPCD locations and decode the Sideband Channel Communication messages. Unigraf also provides a custom cable for use with the DP 1.2 monitoring. The custom cable bypasses the main links outside DPA-400 as shown in the illustration above.

Note	Please use the custom cable supplied with DPA-400 1.2 when monitoring DisplayPort version 1.2 signals. DPA-400 hardware is not compatible with the HBR2 main link bit rate. The custom cable bypasses main links outside DPA-400.

Note	Please make sure that you have connected the DP cables right: *DP Source* >> **DP Input**, **DP Output** >> *DP Sink Device*

3. SETUP INSTRUCTIONS

Contents of the Delivery

The DPA-400 1.2 installation package includes the following items:

- DPA-400 Setup installer
- Firmware updater utility
- Latest DPA-400 firmware
- The release notes (DPA-400_release_notes.txt)
- This manual (DP_AUXMon.pdf)

DPA-400 1.2 delivery also includes a custom cable for DisplayPort version 1.2 monitoring.

Product Setup

The DPA-400 unit features an USB to serial conversion controller. Therefore its Windows driver will be installed as a virtual serial port named as a *DPA-400 USB Serial Port*. Please, use the USB Serial Port driver installed by DPA-400 installer.

Note:	System administrator's privileges are required for performing the installation.

Installing the DPA-400

In order to install the DPA-400 software and driver please follow these steps:

- ▶ Power up your PC
- ▶ Open the folder containing DPA-400 installation package
- ▶ Run **DPA-400 Setup.exe** found in the installation package
- ▶ In the **Choose Components** dialog please indicate if you need the device drivers to be installed at this time.
- ▶ In the following dialogs, indicate the folder where the files will be installed and the Start Menu folder for the program shortcuts.

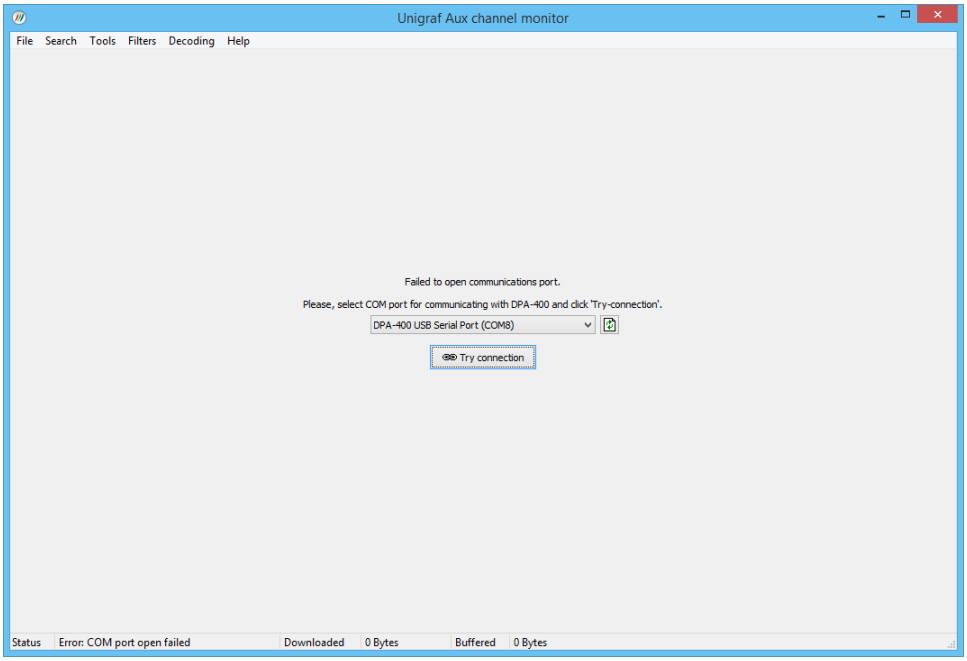
  DPA-400 software and firmware will now be installed to your PC.
- ▶ Plug in the DPA-400 unit in a vacant USB port of your PC
- ▶ Run **DP-Aux Channel Monitor** application

GUI Setup

In order the DPA-400 graphical user interface (GUI) application to communicate with the firmware in the DPA-400 unit you have to set up the COM port used and provide the license code delivered with the unit.

Selecting the COM Port Used

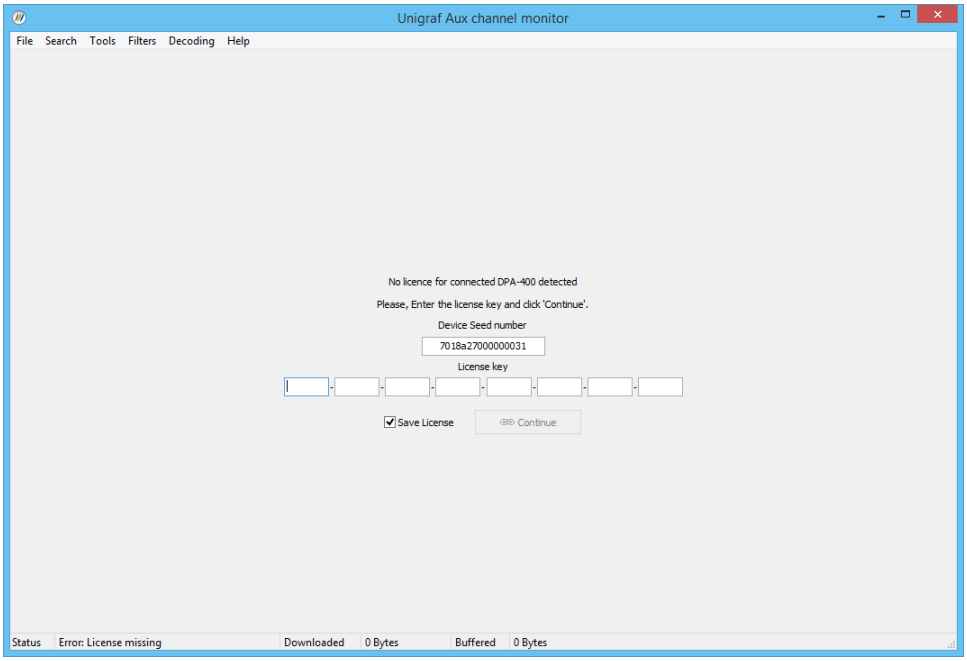
- From the GUI pull down menu in the center of the GUI and select the serial port used for communicating with the DPA-400. It will in most cases be named as *DPA-400 USB Serial Port*



Adding the License Key

You will need a hardware specific license key for using Unigraf DPA-400 or DPA-400 1.2 GUI. Each license is valid for one specific device only. By using the GUI you can read the *Seed Number* of your DPA-400 unit. For a given Seed Number, Unigraf will provide you a *License Key* that will enable you to use the GUI from any PC to control your DPA-400.

- You can usually find your DPA-400 License Key on a sticker glued on its enclosure, in the delivery package or among its related documents. If you cannot locate the License Key, please email to Unigraf the *Seed Number* shown on the dialog in order to receive your License Key.
- Insert each of the 32 character long License Key in the field provided and click the Continue. The license key is now saved in your PC and you can constantly use the device from this PC. Please Click Close to return to the main window.



Note	Please note that each Unigraf DPA-400 GUI license is bound to one specific DPA-400 or DPA-400 1.2 unit. The same license can be used with any number of PCs.

Note	Please note that DPA-400 versions 1.1.1 and lower (DPA-400) and versions 1.2.0 and higher (DPA-400 1.2) accept a different license key. In order to acquire an upgrade license from DPA-400 to DPA-400 1.2 please contact Unigraf.

Note	The License Key never includes characters I, G, B, O because of their similarity with the corresponding numbers. If in doubt, please use numbers. You can use copy and paste to insert the License Key.

Note	The DPA-400 must be connected to your PC for entering the License Key.

DPA-400 Firmware Upgrade

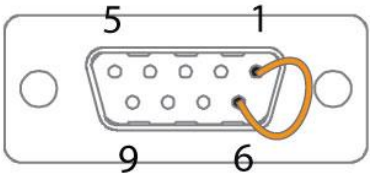
When delivered, a DPA-400 is readily programmed with the firmware matching the software in the delivery package. You can start right away using it and skip reading the rest of this chapter.

When Unigraf adds features or improves either the DPA-400 GUI or its firmware, you are entitled to download from Unigraf download page (or you will receive as an email) a new delivery package including a new installer for the GUI application and, if needed, an update DPA-400 firmware file.

When launching the GUI, it will verify that the firmware programmed in the DPA-400 unit is matching the GUI version. If upgrade is needed the GUI will prompt the user to update the firmware.

Please follow these steps in order to upgrade your DPA-400 internal firmware:

- Unplug the DPA-400 USB cable.
- With a length of wire, short-circuit pins 1 and 6 of the digital I/O connector. Try to make a good contact by inserting at least ½" of bare conductor in each of the connector pin holes.



- Plug the DPA-400 USB cable to your PC.
- Locate the COM port used by your DPA-400 (for instance, COM3) .
- Open a command prompt window and go to the directory where UUFUpd.exe and the rest of the delivery package reside.
- From the command prompt run:

```
uufupd -c 3 -f dpa-400.uuf
```

- (substitute "3" with the number of your COM port and "dpa-400.uuf" with the file name included in your package)
- The UUFUpd utility will upgrade the DPA-400 firmware while printing a series of dots. Please wait for its completion without removing the USB cable.
- When the message "DONE" is printed, please remove the short-circuit from the I/O connector and unplug the USB cable. Your DPA-400 is now upgraded with its latest firmware.

In case you receive an error message from the UUFUpd utility, please restart the above procedure from its very beginning (USB cable unplugged) and verify that the short-circuit you use makes a good contact and to the right pins.

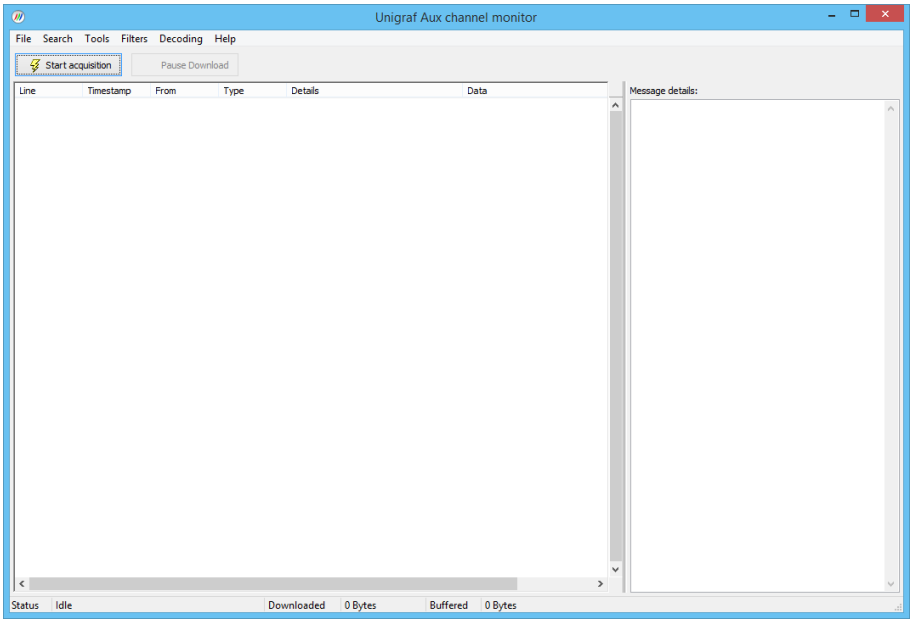
Note	After a firmware upgrade, the DPA-400 USB cable must be unplugged and plugged once for the device to be again functional.

4. DATA ACQUISITION

Unigraf DP AUX Channel Monitor consists of DPA-400 unit for connecting to the DisplayPort™ link and a Graphical User Interface (GUI) application for operating it and creating reports. The serial communication setup and License Key entry are covered in the *Setup Instructions* section of this manual. The following sections describe the process of acquiring AUX channel data. Generating data reports is covered in its own chapter.

Getting Ready

Plug your DPA-400 to your PC and start the GUI application. Verify that the right COM port is selected, a valid License Key is available and the GUI main window opens.



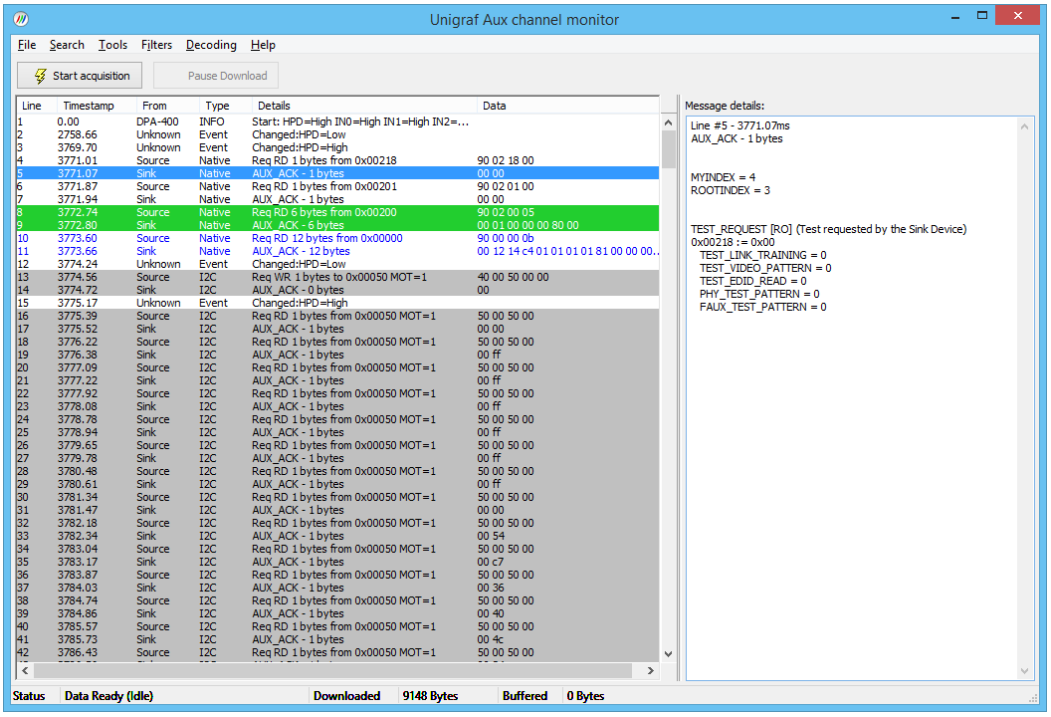
If required, connect your external input signals to the DPA-400 I/O connector using a suitable cable.

Note	In order to ensure the signal integrity of HBR2 main data lane speed introduced in DisplayPort version 1.2 standard you will need to use the custom DP cable supplied with the delivery of DPA-400 1.2 or the Upgrade package. DPA-400 hardware is not compatible with HBR2 data transfer speed.

Note	Please make sure that you have connected the DP cables right: *DP Source* >> **DP Input**, **DP Output** >> *DP Sink Device*

The Main Window

The GUI main window is divided into two sections. The **Transaction list** in the left displays the acquired AUX channel transactions and events. The **Message details** panel on the right side of the window shows the interpretation of the currently selected AUX channel transaction line. The **Start acquisition** button controls the start and stop of the data acquisition. The **Status line** at the bottom of the window shows the current GUI state, the amount of data already downloaded to it and the amount of data still stored in the DPA-400 internal memory (buffered) and waiting for downloading.


Unigraf Aux channel monitor
File Search Tools Filters Decoding Help
Start acquisition
Pause Download
Line Timestamp From Type Details Data
1 0.00 DPA-400 INFO Start: HPD=High IN0=High IN1=High IN2=...
2 2758.66 Unknown Event Changed:HPD=Low
3 3769.70 Unknown Event Changed:HPD=High
4 3771.01 Source Native Req RD 1 bytes from 0x00218 90 02 18 00
5 3771.07 Sink Native AUX_ACK - 1 bytes 00 00
6 3771.87 Source Native Req RD 1 bytes from 0x00201 90 02 01 00
7 3771.94 Sink Native AUX_ACK - 1 bytes 00 00
8 3772.74 Source Native Req RD 6 bytes from 0x00200 90 02 00 05
9 3772.80 Sink Native AUX_ACK - 6 bytes 00 01 00 00 00 80 00
10 3773.60 Source Native Req RD 12 bytes from 0x00000 90 00 00 0b
11 3773.66 Sink Native AUX_ACK - 12 bytes 00 12 14 c4 01 01 01 01 81 00 00 00..
12 3774.24 Unknown Event Changed:HPD=Low
13 3774.56 Source I2C Req WR 1 bytes to 0x00050 MOT=1 40 00 50 00 00
14 3774.72 Sink I2C AUX_ACK - 0 bytes 00
15 3775.17 Unknown Event Changed:HPD=High
16 3775.39 Source I2C Req RD 1 bytes from 0x00050 MOT=1 50 00 50 00
17 3775.52 Sink I2C AUX_ACK - 1 bytes 00 00
18 3776.22 Source I2C Req RD 1 bytes from 0x00050 MOT=1 50 00 50 00
19 3776.38 Sink I2C AUX_ACK - 1 bytes 00 ff
20 3777.09 Source I2C Req RD 1 bytes from 0x00050 MOT=1 50 00 50 00
21 3777.22 Sink I2C AUX_ACK - 1 bytes 00 ff
22 3777.92 Source I2C Req RD 1 bytes from 0x00050 MOT=1 50 00 50 00
23 3778.08 Sink I2C AUX_ACK - 1 bytes 00 ff
24 3778.78 Source I2C Req RD 1 bytes from 0x00050 MOT=1 50 00 50 00
25 3778.94 Sink I2C AUX_ACK - 1 bytes 00 ff
26 3779.65 Source I2C Req RD 1 bytes from 0x00050 MOT=1 50 00 50 00
27 3779.78 Sink I2C AUX_ACK - 1 bytes 00 ff
28 3780.48 Source I2C Req RD 1 bytes from 0x00050 MOT=1 50 00 50 00
29 3780.61 Sink I2C AUX_ACK - 1 bytes 00 ff
30 3781.34 Source I2C Req RD 1 bytes from 0x00050 MOT=1 50 00 50 00
31 3781.47 Sink I2C AUX_ACK - 1 bytes 00 00
32 3782.18 Source I2C Req RD 1 bytes from 0x00050 MOT=1 50 00 50 00
33 3782.34 Sink I2C AUX_ACK - 1 bytes 00 54
34 3783.04 Source I2C Req RD 1 bytes from 0x00050 MOT=1 50 00 50 00
35 3783.17 Sink I2C AUX_ACK - 1 bytes 00 c7
36 3783.87 Source I2C Req RD 1 bytes from 0x00050 MOT=1 50 00 50 00
37 3784.03 Sink I2C AUX_ACK - 1 bytes 00 36
38 3784.74 Source I2C Req RD 1 bytes from 0x00050 MOT=1 50 00 50 00
39 3784.86 Sink I2C AUX_ACK - 1 bytes 00 40
40 3785.57 Source I2C Req RD 1 bytes from 0x00050 MOT=1 50 00 50 00
41 3785.73 Sink I2C AUX_ACK - 1 bytes 00 4c
42 3786.43 Source I2C Req RD 1 bytes from 0x00050 MOT=1 50 00 50 00
Message details:
Line #5 - 3771.07ms
AUX_ACK - 1 bytes
MYINDEX = 4
ROOTINDEX = 3
TEST_REQUEST [RO] (Test requested by the Sink Device)
0x00218 := 0x00
TEST_LINK_TRAINING = 0
TEST_VIDEO_PATTERN = 0
TEST_EDID_READ = 0
PHY_TEST_PATTERN = 0
FAUX_TEST_PATTERN = 0
Status Data Ready (Idle) Downloaded 9148 Bytes Buffered 0 Bytes

Note	Please note that the **Filters** function found in the Main Window in some previous versions of the GUI can now be found as a pull down menu. Its function is described later in this document.

Controlling the Acquisition

The start and stop conditions of the data acquisition and monitoring of optional signals can be defined in the corresponding dialogs. Please consult Appendix B to find out how these external signals can be connected to your DPA-400.

Starting and Stopping Data Acquisition

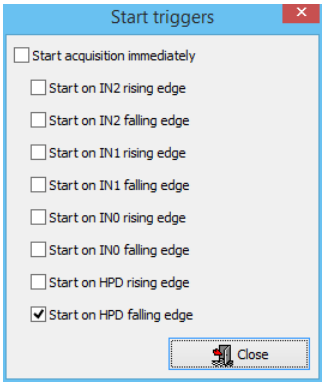
By default, the data acquisition is started immediately after the **Start acquisition** pushbutton in the *Main window* is pressed. Additional conditions can be set in the *Start triggers* dialog.

▶ Select Tools -> Start triggers…

By default the **Start acquisition immediately** option is selected. By deselecting it you can select one or the more of the advanced options:

- Start on the rising or falling edge of HPD signal
- Start on the rising or falling edge of IN0 signal
- Start on the rising or falling edge of IN1 signal
- Start on the rising or falling edge of IN2 signal

The acquisition will start after the Start acquisition pushbutton is pressed and when any of the selected conditions is verified.


Start triggers
Start acquisition immediately
Start on IN2 rising edge
Start on IN2 falling edge
Start on IN1 rising edge
Start on IN1 falling edge
Start on IN0 rising edge
Start on IN0 falling edge
Start on HPD rising edge
Start on HPD falling edge
Close

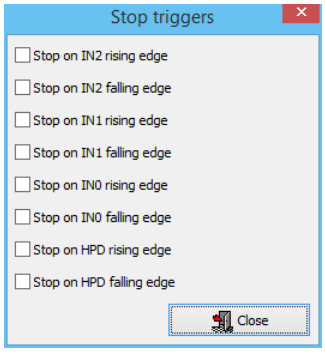
Data acquisition can be manually stopped at any time by pressing the **Stop acquisition** pushbutton in the *Main window*. Optionally, the acquisition can be stopped automatically when one of the enabled stop conditions is verified.

▶ Select Tools -> Stop triggers…

You can select one or the more of the advanced options:

- Stop on the rising or falling edge of HPD signal
- Stop on the rising or falling edge of IN0 signal
- Stop on the rising or falling edge of IN1 signal
- Stop on the rising or falling edge of IN2 signal

The acquisition will stop automatically when any of the selected conditions is verified.

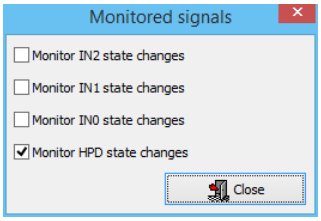

Stop triggers
Stop on IN2 rising edge
Stop on IN2 falling edge
Stop on IN1 rising edge
Stop on IN1 falling edge
Stop on IN0 rising edge
Stop on IN0 falling edge
Stop on HPD rising edge
Stop on HPD falling edge
Close

Monitored Signals

In addition to the AUX channel traffic, you can also monitor the status of four digital signals. By default, only the HPD signal is monitored. In the *Monitored signals* dialog you can include also one or more of the external digital signals IN0, IN1 and IN2.

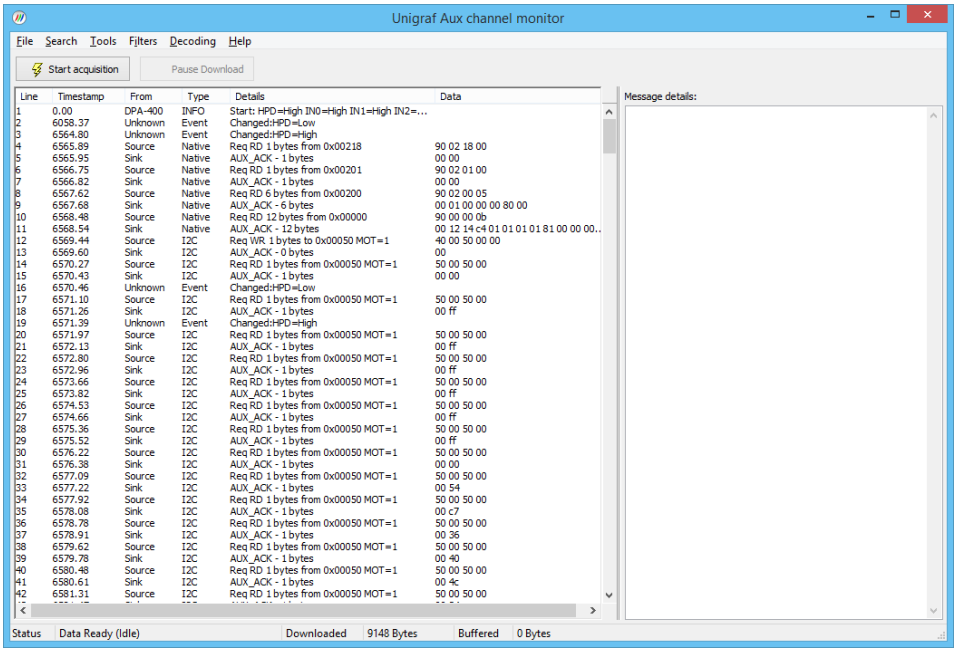
▶ Select Tools > Monitored signals…

The dialog allows you to select the monitored signals.



Acquiring Data

- Plug your source and sink devices to the DPA-400 as described in section Getting Ready of this chapter.
- Select the signals to be monitored or check that the HPD is selected.
- Check the start and stop triggers.
- Finally press the **Start Acquisition** button.


Unigraf Aux channel monitor
File Search Tools Filters Decoding Help
Start acquisition
Pause Download
Message details:
Status Data Ready (Idle) Downloaded 9148 Bytes Buffered 0 Bytes

The GUI enables automatically data download and data is displayed in the *Transaction List* as soon as it is acquired and reaches the GUI. From the Status line at the bottom of the Main window you can monitor the amount of downloaded data and how much data is still waiting to be downloaded.

Usually the buffered data amount always read as zero, meaning that all of the acquired data has been downloaded to the GUI. When a quick and long sequence of transactions is acquired or when a rapidly toggling external input is monitored, the DPA-400 internal buffer can fill-up much more rapidly than what the GUI is capable of downloading.

- If the DPA-400 buffer gets filled with a large amount of data, you can pause the download by pressing the Pause Download pushbutton.
- After inspecting the downloaded data, you can decide to resume the download to gather more data by pressing the Download pushbutton.
- If the acquisition is not stopped automatically by one of the selected stop triggers, you can force its termination by pressing the Stop Acquisition pushbutton.

Note	Restarting the data acquisition clears the DPA-400 internal buffer and the GUI downloaded data!

Decoding the Data

Release version 1.2.0 and later DPA-400 GUI is compatible with both DisplayPort™ versions 1.1b and 1.2. You can select which version is used and how the messages will be decoded.

▶ From the pull-down menu select **Decoding** and select the version.

You can select

- DPCD 1.1 Decoder
- DPCD 1.2 Decoder
- Additionally you can indicate if DETAILED_CAP_INFO_AVAILBLE bit is set

Note	Please note that DPA-400 versions 1.1.1 and lower (DPA-400) and versions 1.2.0 and higher (DPA-400 1.2) accept a different license key. In order to acquire an upgrade license from DPA-400 to DPA-400 1.2 please contact Unigraf.

Inspecting the Acquired Data

The data acquired by the DPA-400 and downloaded to the GUI is shown in the *Transaction list.* Please refer to chapter *Customizing the Main Window* below for details on how to modify the content and look of the *Transaction list.*

The data is organized in lines, each numbered starting from 1 and marked with a timestamp. There are four kinds of lines:

1. Information lines

Identified by the text “INFO” in their Type column, they provide some useful information like the time acquisition has started and stopped or the logical state of the inputs, etc.

2. Transaction lines

Identified by the text “Native” or “I2C” in their Type column, they report an AUX channel data transfer, either a data Request or a data Reply.

3. Event lines

Identified by the text “Event” in their Type column, they signal the state change in one or more of the monitored inputs.

4. Sideband Channel Messages

The Isochronous Transport Service uses the sideband communications over sideband channel (AUX CH and HPD) for the management of topology/virtual channel connection/Main Link and performs Main Link symbol mapping.

5. Error lines

A line Type reading “Error” marks the detection of an illegal AUX channel data packet. An irregular start condition, an irregular stop condition or transfer of a number of bits which is not a multiple of 8 are all conditions that cause an error line.

The data on each line is ordered in columns. Each column provides additional information about the data line, facilitating its viewing and interpretation:

Line

This column displays the line number, starting from 1, and cannot be hidden.

Timestamp

Each line is identified by its timestamp, marking the instant when an event or error was detected, or when a data transaction got started. The timestamp can be displayed as a time delay from the start of the acquisition (absolute) or from the previous line (relative). The timestamp can be displayed in milliseconds or in minutes, seconds and microseconds.

From

This column indicates the originator of the data line:

- "**Source**" and "**Sink**" for an AUX channel transaction, respectively a data Request and a data Reply.
- "**Source Trace**" and "**Sink Trace**" respectively for Sideband Message data Request and Reply.
- "**DPA-400**" for error and information lines.
- "**Unknown**" for signal state change events.

Type

This column provides additional information about the type of the line:

- "**Native**" marks Native AUX channel Requests and Replies.
- "**I2C**" marks I2C AUX channel Requests and Replies.
- "**Sideband Request**" and "**Sideband Reply**" to mark the Sideband Channel messages
- "**Event**" is used for signal state change events.
- "**INFO**" is used with information lines.
- "**Error**" is used for illegal conditions detected on the AUX channel.

Details

This column contains an abbreviated description of the line content in textual form.

Data

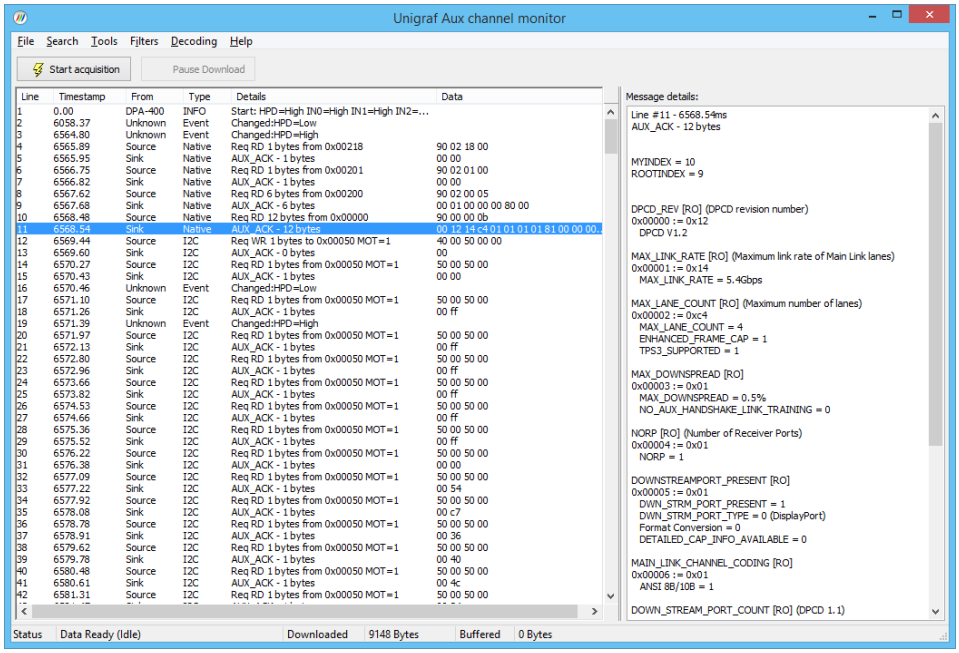
The binary data exchanged during AUX channel transactions, in hexadecimal notation.

Note	Please make sure that you have connected the DP cables right: *DP Source* >> **DP Input**, **DP Output** >> *DP Sink Device*

Message Details

The *Message details* panel is used to provide a detailed explanation of the line currently selected in the *Transaction list*. For AUX channel transaction lines, for each of the DPCD memory locations affected, the panel lists:

- All data bytes read or written.
- All DPCD memory locations affected.
- The name of the locations and of each of their bit fields.
- All bit field's numeric and binary values, together with their decoded value.
- The Replies outcome (AUX_ACK, AUX_NACK, I2C_DEFER, etc.).


Unigraf Aux channel monitor
File Search Tools Filters Decoding Help
Start acquisition
Pause Download
Line Timestamp From Type Details Data
1 0.00 DPA-400 INFO Start: HPD=High IN0=High IN1=High IN2=...
2 6058.37 Unknown Event Changed:HPD=Low
3 6564.80 Unknown Event Changed:HPD=High
4 6565.89 Source Native Req RD 1 bytes from 0x00218 90 02 18 00
5 6565.95 Sink Native AUX_ACK - 1 bytes 00 00
6 6566.75 Source Native Req RD 1 bytes from 0x00201 90 02 01 00
7 6566.82 Sink Native AUX_ACK - 1 bytes 00 00
8 6567.62 Source Native Req RD 6 bytes from 0x00200 90 02 00 05
9 6567.68 Sink Native AUX_ACK - 6 bytes 00 01 00 00 00 80 00
10 6568.48 Source Native Req RD 12 bytes from 0x00000 90 00 00 0b
11 6568.54 Sink Native AUX_ACK - 12 bytes 00 12 14 c4 01 01 01 01 81 00 00 00..
12 6569.44 Source I2C Req WR 1 bytes to 0x00050 MOT=1 40 00 50 00 00
13 6569.60 Sink I2C AUX_ACK - 0 bytes 00
14 6570.27 Source I2C Req RD 1 bytes from 0x00050 MOT=1 50 00 50 00
15 6570.43 Sink I2C AUX_ACK - 1 bytes 00 00
16 6570.46 Unknown Event Changed:HPD=Low
17 6571.10 Source I2C Req RD 1 bytes from 0x00050 MOT=1 50 00 50 00
18 6571.26 Sink I2C AUX_ACK - 1 bytes 00 ff
19 6571.39 Unknown Event Changed:HPD=High
20 6571.97 Source I2C Req RD 1 bytes from 0x00050 MOT=1 50 00 50 00
21 6572.13 Sink I2C AUX_ACK - 1 bytes 00 ff
22 6572.80 Source I2C Req RD 1 bytes from 0x00050 MOT=1 50 00 50 00
23 6572.96 Sink I2C AUX_ACK - 1 bytes 00 ff
24 6573.66 Source I2C Req RD 1 bytes from 0x00050 MOT=1 50 00 50 00
25 6573.82 Sink I2C AUX_ACK - 1 bytes 00 ff
26 6574.53 Source I2C Req RD 1 bytes from 0x00050 MOT=1 50 00 50 00
27 6574.66 Sink I2C AUX_ACK - 1 bytes 00 ff
28 6575.36 Source I2C Req RD 1 bytes from 0x00050 MOT=1 50 00 50 00
29 6575.52 Sink I2C AUX_ACK - 1 bytes 00 ff
30 6576.22 Source I2C Req RD 1 bytes from 0x00050 MOT=1 50 00 50 00
31 6576.38 Sink I2C AUX_ACK - 1 bytes 00 00
32 6577.09 Source I2C Req RD 1 bytes from 0x00050 MOT=1 50 00 50 00
33 6577.22 Sink I2C AUX_ACK - 1 bytes 00 54
34 6577.92 Source I2C Req RD 1 bytes from 0x00050 MOT=1 50 00 50 00
35 6578.08 Sink I2C AUX_ACK - 1 bytes 00 c7
36 6578.78 Source I2C Req RD 1 bytes from 0x00050 MOT=1 50 00 50 00
37 6578.91 Sink I2C AUX_ACK - 1 bytes 00 36
38 6579.62 Source I2C Req RD 1 bytes from 0x00050 MOT=1 50 00 50 00
39 6579.78 Sink I2C AUX_ACK - 1 bytes 00 40
40 6580.48 Source I2C Req RD 1 bytes from 0x00050 MOT=1 50 00 50 00
41 6580.61 Sink I2C AUX_ACK - 1 bytes 00 4c
42 6581.31 Source I2C Req RD 1 bytes from 0x00050 MOT=1 50 00 50 00
Message details:
Line #11 - 6568.54ms
AUX_ACK - 12 bytes
MYINDEX = 10
ROOTINDEX = 9
DPCD_REV [RO] (DPCD revision number)
0x00000 := 0x12
DPCD V1.2
MAX_LINK_RATE [RO] (Maximum link rate of Main Link lanes)
0x00001 := 0x14
MAX_LINK_RATE = 5.4Gbps
MAX_LANE_COUNT [RO] (Maximum number of lanes)
0x00002 := 0xc4
MAX_LANE_COUNT = 4
ENHANCED_FRAME_CAP = 1
TPS3_SUPPORTED = 1
MAX_DOWNSPREAD [RO]
0x00003 := 0x01
MAX_DOWNSPREAD = 0.5%
NO_AUX_HANDSHAKE_LINK_TRAINING = 0
NORP [RO] (Number of Receiver Ports)
0x00004 := 0x01
NORP = 1
DOWNSTREAMPORT_PRESENT [RO]
0x00005 := 0x01
DWN_STRM_PORT_PRESENT = 1
DWN_STRM_PORT_TYPE = 0 (DisplayPort)
Format Conversion = 0
DETAILED_CAP_INFO_AVAILABLE = 0
MAIN_LINK_CHANNEL_CODING [RO]
0x00006 := 0x01
ANSI 8B/10B = 1
DOWN_STREAM_PORT_COUNT [RO] (DPCD 1.1)
Status Data Ready (Idle) Downloaded 9148 Bytes Buffered 0 Bytes

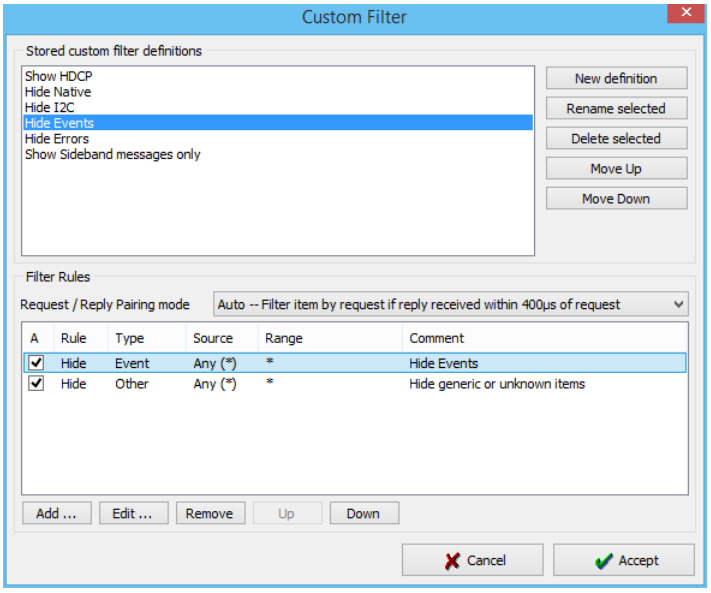
Filtering

In the *Filters* drop down menu you can set up rules describing which data lines are shown in the Transaction List. You can choose the data based on:

- The type of data line
- The origin of the message
- The DPCD address range

In the *Filters* drop down menu you can find by default a set of pre-programmed filters.

The *Custom Filter* dialog provides you a possibility to add and modify new filters. The pre-programmed filters are listed in the dialog. You can copy their structure as bases of your custom filters. It is advisable not to modify the pre-programmed filters directly but make copies of them.

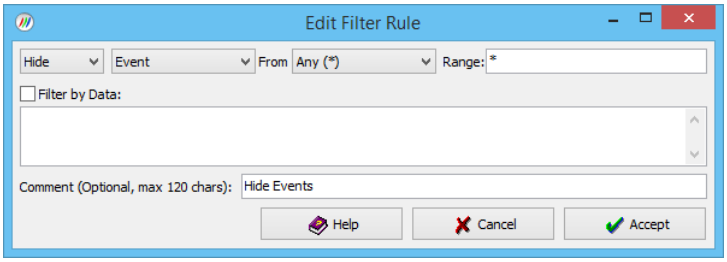


In the *Stored custom filter* definitions panel you will have the list of currently defined Filters. On the right hand side buttons you can define new Filters, rename or delete them. You can also reorder their appearance in the *Filters* pull-down menu.

In the *Filter Rules* panel lower in the dialog you can review and change the *Rules* in the selected *Filter*. By clicking **Add…** you can create new rules, clicking **Edit…** you can review and edit existing Filters and by clicking **Remove** from the Filter definition.

When you click Add… or Edit… *Edit Filter Rule* dialog opens. In the dialog you can in detail define the action of the rule, select the event and the event details.

You can get help by clicking **Help**. The "Help" text is attached to Appendix C of this document.



Note	Please note that Filters are a very powerful tool. They can however unintentionally hide valuable data from you. Please be careful when applying custom filters. A good practice is to start from an existing filter and gradually add new rules while testing their performance.

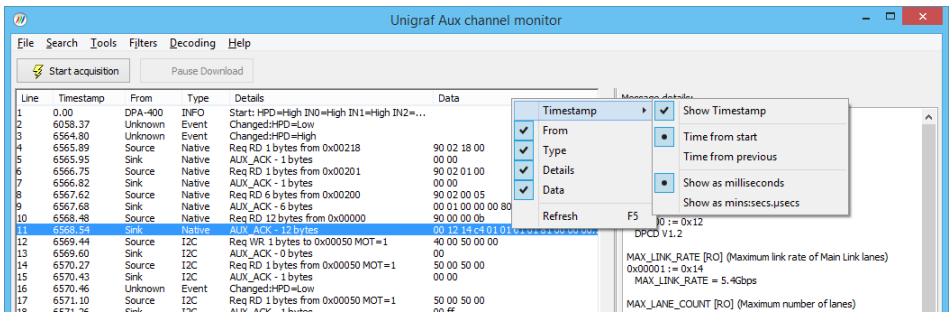
Note	Filtering and selecting the columns for display do not affect the actual data acquisition. All transactions and their full data are always captured.

Customizing the Main Window

You can change the format of the data shown in the *Transaction list* and the *Message details* panels in order to highlight the details of your interest.

Selecting Data Columns

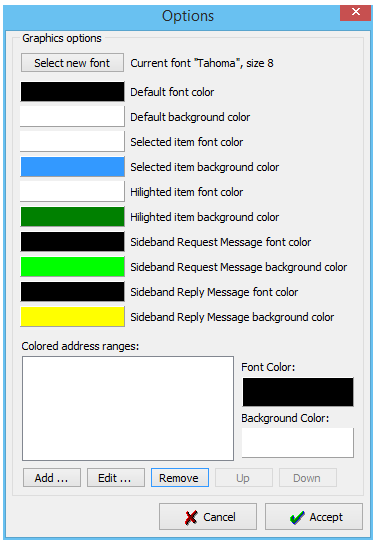
You can customize the *Transaction list* by clicking the right button of your mouse over the list. From the pop-up menu, you can choose which columns to display, the style of the timestamp and switch between absolute and relative timestamps.



Selecting Font and Colors

You can select the font style and size used for displaying the *Transaction list* and the *Message details.*

- Select **Tools -> Options ...** . In the Options dialog press **Select new font** and choose the font that you want to use.

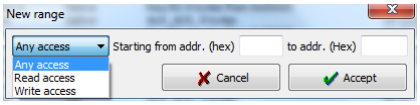


You can select the colors for the font and background of various items.

Coloring DPCD Address Ranges

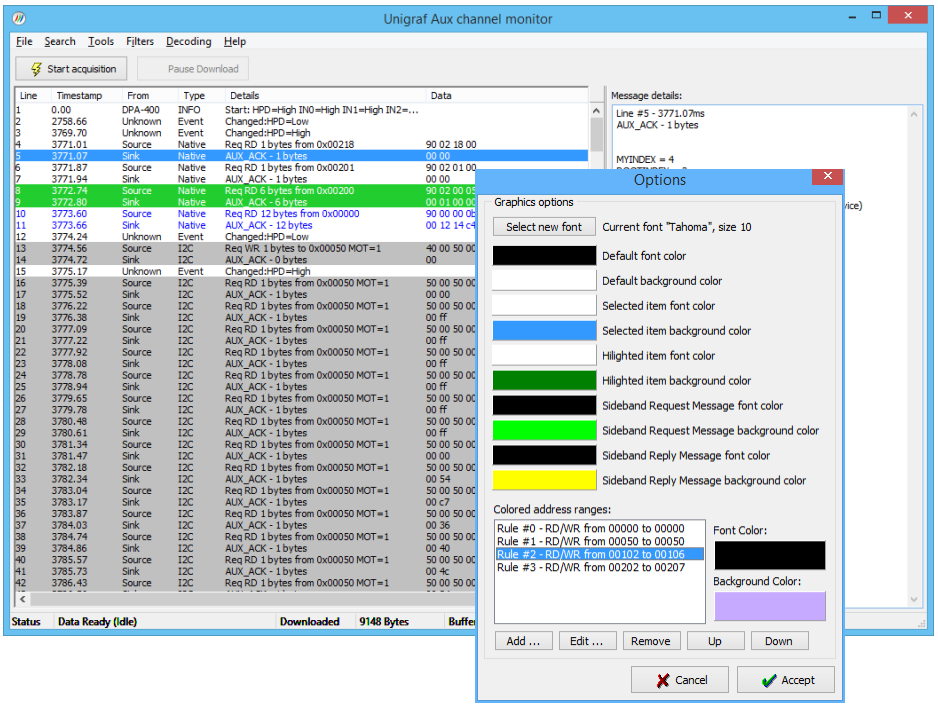
In order to improve the readability of the *Transaction list*, you can mark the AUX channel transactions where a certain DPCD register address or address range is accessed with a color of your choice.

- Select **Tools > Options ...** . In the Option dialog press **Add….**
- In the New range dialog select the access type, start address and end address of the range that you want to be colored. Press **Accept**.



- Select the range you just created from the Colored addresses ranges list and click the **Font Color** and **Background Color** buttons to select the colors desired.

You can create multiple simultaneous coloring rules to help you get a better view of the data captured.

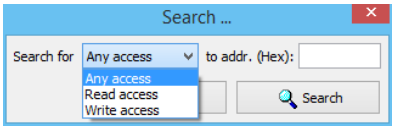


Searching for Data

You can search and highlight all lines in the *Transaction list* representing an AUX channel access to a selected DPCD location.

- Use **Search -> Find…** or press **Ctrl + F**. In the Search dialog select the access type and the DPCD location address that you want to search.

  The first occurrence of the found access is selected and the rest are highlighted.



- After a new acquisition you can use the same search criteria and select **Search -> Find again** or just press **F3**.

5. SAVING YOUR DATA

After the acquisition is stopped, the data displayed in the *Transaction list* can be saved to a file in binary format or in a readable HTML format as a report. In its binary form, the saved data can only be opened by the DPA-400 GUI while in HTML format it can be opened with any available HTML browser.

Saving to a Binary File

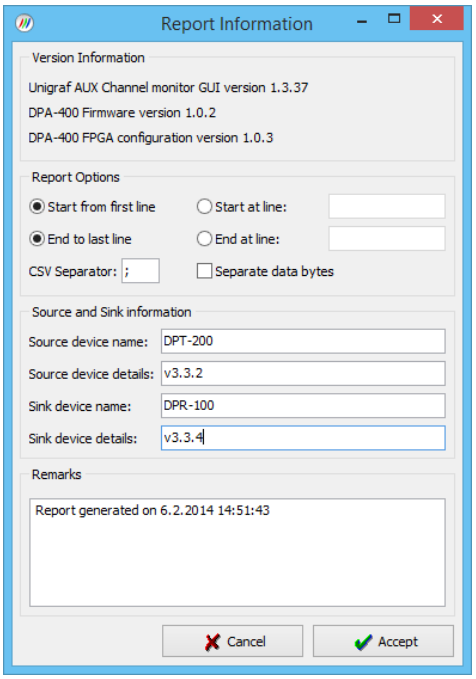
From the pull down menu select **File -> Save** or **File -> Save As …** and specify the name for the file to be saved. You can reload a previously saved file for later inspection using **File -> Load**.

The DPA-400 GUI application includes a report generator that creates a test report of the results displayed in the Results Grid. The report is generated in HTML format and includes a detailed description of the test steps executed, the actions taken and the causes of the pass or failure. You can also include detailed description of the monitored source and sink and the used TE in the report.

Creating a Test Report

The report generated by the GUI application includes all the lines from the *Transaction list* and the content of the *Message details* panel for each of them. For creating a report select from the pull down menu **File -> Save Report ….**

After selecting the report file name, in the *Report Information* dialog you can add a description of the monitored source and sink devices, and your personal remarks that will be included in the report.



Save the report by clicking **Accept** or return to the main window without saving by clicking C**ancel**. After the report is saved, your default internet browser will be opened to display the report file created.

The information entered in the dialog fields will be available also for the following reports until the GUI is closed.

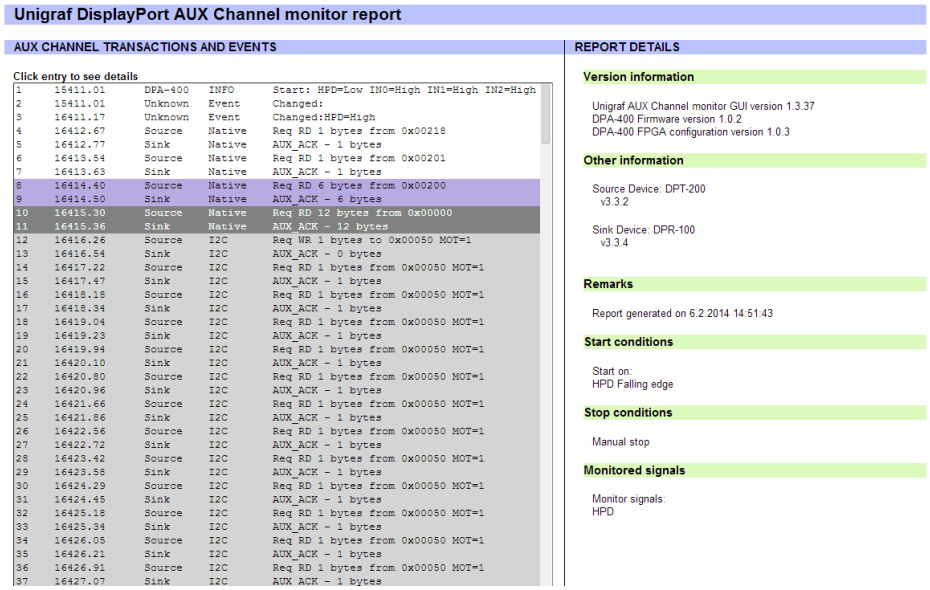
Note	You can create reports from previously acquired data that has been saved in binary format. Use first **File -> Load** and then **File > Save Report ….**

Note	Report creation for large amounts of acquired data can generate large HTML files and take several minutes. During this operation the GUI will not respond to user commands. Please, be patient.

Test Report Views

When you save a report file or open a previously saved report, your internet browser will open the report default view.

Note how each time you select a report line the transaction details at the left shows a lot of useful information about the data involved.



Unigraf DisplayPort AUX Channel monitor report

AUX CHANNEL TRANSACTIONS AND EVENTS

Click entry to see details

1	15411.01	DPA-400	INFO	Start: HPD=Low IN0=High IN1=High IN2=High
2	15411.01	Unknown	Event	Changed:
3	16411.17	Unknown	Event	Changed:HPD=High
4	16412.67	Source	Native	Req RD 1 bytes from 0x00218
5	16412.77	Sink	Native	AUX_ACK - 1 bytes
6	16413.54	Source	Native	Req RD 1 bytes from 0x00201
7	16413.63	Sink	Native	AUX_ACK - 1 bytes
8	16414.40	Source	Native	Req RD 6 bytes from 0x00200
9	16414.50	Sink	Native	AUX_ACK - 6 bytes
10	16415.30	Source	Native	Req RD 12 bytes from 0x00000
11	16415.36	Sink	Native	AUX_ACK - 12 bytes
12	16416.26	Source	I2C	Req WR 1 bytes to 0x00050 MOT=1
13	16416.54	Sink	I2C	AUX_ACK - 0 bytes
14	16417.22	Source	I2C	Req RD 1 bytes from 0x00050 MOT=1
15	16417.47	Sink	I2C	AUX_ACK - 1 bytes
16	16418.18	Source	I2C	Req RD 1 bytes from 0x00050 MOT=1
17	16418.34	Sink	I2C	AUX_ACK - 1 bytes
18	16419.04	Source	I2C	Req RD 1 bytes from 0x00050 MOT=1
19	16419.23	Sink	I2C	AUX_ACK - 1 bytes
20	16419.94	Source	I2C	Req RD 1 bytes from 0x00050 MOT=1
21	16420.10	Sink	I2C	AUX_ACK - 1 bytes
22	16420.80	Source	I2C	Req RD 1 bytes from 0x00050 MOT=1
23	16420.96	Sink	I2C	AUX_ACK - 1 bytes
24	16421.66	Source	I2C	Req RD 1 bytes from 0x00050 MOT=1
25	16421.86	Sink	I2C	AUX_ACK - 1 bytes
26	16422.56	Source	I2C	Req RD 1 bytes from 0x00050 MOT=1
27	16422.72	Sink	I2C	AUX_ACK - 1 bytes
28	16423.42	Source	I2C	Req RD 1 bytes from 0x00050 MOT=1
29	16423.58	Sink	I2C	AUX_ACK - 1 bytes
30	16424.29	Source	I2C	Req RD 1 bytes from 0x00050 MOT=1
31	16424.45	Sink	I2C	AUX_ACK - 1 bytes
32	16425.18	Source	I2C	Req RD 1 bytes from 0x00050 MOT=1
33	16425.34	Sink	I2C	AUX_ACK - 1 bytes
34	16426.05	Source	I2C	Req RD 1 bytes from 0x00050 MOT=1
35	16426.21	Sink	I2C	AUX_ACK - 1 bytes
36	16426.91	Source	I2C	Req RD 1 bytes from 0x00050 MOT=1
37	16427.07	Sink	I2C	AUX_ACK - 1 bytes

REPORT DETAILS

Version information

Unigraf AUX Channel monitor GUI version 1.3.37
DPA-400 Firmware version 1.0.2
DPA-400 FPGA configuration version 1.0.3

Other information

Source Device: DPT-200
v3.3.2

Sink Device: DPR-100
v3.3.4

Remarks

Report generated on 6.2.2014 14:51:43

Start conditions

Start on:
HPD Falling edge

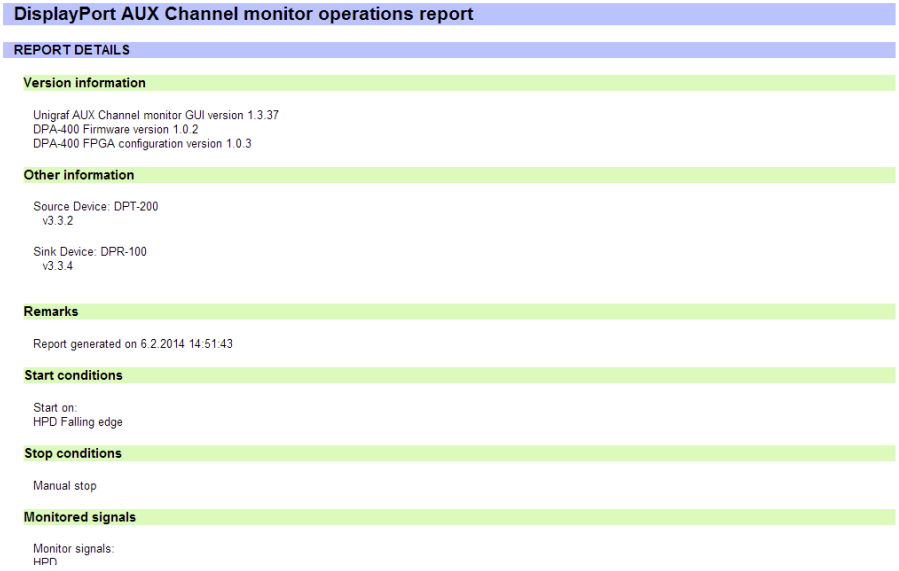
Stop conditions

Manual stop

Monitored signals

Monitor signals:
HPD

In order to print the report, scroll down and click the **Show printer friendly format…** pushbutton to get a new view formatted for an easy printing.



DisplayPort AUX Channel monitor operations report

REPORT DETAILS

Version information

Unigraf AUX Channel monitor GUI version 1.3.37
DPA-400 Firmware version 1.0.2
DPA-400 FPGA configuration version 1.0.3

Other information

Source Device: DPT-200
v3.3.2

Sink Device: DPR-100
v3.3.4

Remarks

Report generated on 6.2.2014 14:51:43

Start conditions

Start on:
HPD Falling edge

Stop conditions

Manual stop

Monitored signals

Monitor signals:
HPD

APPENDIX A: SPECIFICATIONS

General

Functionality	Real-time AUX channel traffic capturing, decoding and display. Data store and reload in binary format. HTML report generation. Internal 14 MByte capture buffer. AUX transactions as fast as 0.5 ms per transaction (Request + Reply). Input state changes monitored up to 8000 changes / s. Timestamps with 32 µs resolution.
Operating Systems	Windows® XP, 7and 8
Mechanical size	10.5 x 13 x 3.5 cm
Weight	260 grams
Power Consumption	5 V, 400 mA

Interfaces

Features:

DisplayPort™ Interfaces	One DisplayPort™ receptacle input connector. One DisplayPort™ receptacle output connector. AUX channel and HPD signals pass-through. Main stream lanes buffered with 1:1 amplification (maximum band with 2.7 Gbps). Pin 20 (DP_PWR) pass-through
Custom I/O	Sub-D 9 socket (female). 3 trigger inputs, link HPD signal. 4 expansion outputs. ESD protection on all external signals.
PC Interface	USB interface, USB-powered. Software upgrade capability through USB

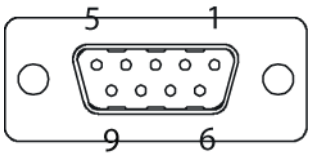
Electrical characteristics:

Trigger inputs	5V tolerant. 3.3V CMOS input levels. IEC 61000-4-2 (ESD) 8kV (air), 6kV (contact)
DisplayPort™ signals	IEC 61000-4-2 (ESD) 8kV (air), 6kV (contact)

APPENDIX B: I/O CONNECTOR

You can use three external trigger signals to start or stop the data acquisition. The trigger signals are available on the SubD-9 socket connector of the DPA-400. Please refer to the **Start triggers** and **Stop triggers** dialogs to control the triggers functionality.

The HPD_IO signal is also available on this connector to provide you an easy measurement access to the HPD signal driven by your DisplayPort™ sink and connected to your DisplayPort™ source device.



Pin	Signal Name	Direction
1	IN0	Input
2	IN1	Input
3	IN2	Input
4	HPD_IO	Output
5	OUT0	Output
6	OUT1	Output
7	OUT2	Output
8	OUT3	Output
9	GND	-

IN0: external input trigger 0.

IN1: external input trigger 1.

IN2: external input trigger 2.

HPD_IO: HPD signal common to the DisplayPort sink and source devices.

OUT0 – OUT3: for future expansions.

GND: electrical reference ground.

APPENDIX C: ADVANCED FILTERS

The following help text can be seen as well by clicking the Help button of the *Edit Filter Rule* dialog.

Note	Please note that Filters are a very powerful tool. They can however unintentionally hide valuable data from you. Please be careful when applying custom filters. A good practice is to start from an existing filter and gradually add new rules while testing their performance.

Note	Filtering and selecting the columns for display do not affect the actual data acquisition. All transactions and their full data are always captured.

Data pattern expressions

A data-pattern expression is a string that describes how to determine if a data-block should be considered as "matched" or "unmatched". The syntax used with data-pattern expressions in DPA-400 Aux Channel Monitor application is described below

The data-block must be covered completely by the data-pattern expression. If the data block is shorter, or longer than the expression, then the data block is determined as "not matched". The '*' wildcard can be used to allow data blocks of any size to match.

Whitespaces and new-lines are ignored, and are allowed anywhere; White spaces and new-lines can be used strategically to make the expression more readable.

For example: "*!(10)??(10)" is the same as "* ! (10) ? ? (10)"

Comment blocks:

Comments must be written enclosed in curly-braces '{' and '}'.

Wildcards

Wildcards used are '*' and '?'

? = Match any single data byte only.

* = Match any number of any data bytes. (including the possibility of matchin NO data bytes)

For data matching, the byte value must be enclosed in braces '(' and ')'. Use prefixes '$' to indicate HEX value, '%' to indicate BIN. No prefix indicates DEC.

Examples:

* ($10) ($00) : Matches any data pattern that has the bytes $10, $00 at end of data.

? ($10) ($00) : Matches 3-byte data pattern that has $10 as second byte and $00 as third byte.

* ($10) * ($00) : Matches any data pattern that has $10 and ending to a $00 byte.

* ($10) * ($00) * : Matches any data pattern that has $10 and $00 after it.

($10) ? * ($20) * : Matches any data pattern that has $10 as first byte, followed by $20 with at least one other byte in between. (i.e. will not match $10, $20)

Use '!' to invert the match:

!($00) = Match any data byte that isn't $00.

Use '?' within HEX or BIN value to ignore that bit in comparison:

($??) = ? = Any data Byte.

($?0) = Any data byte with bits 0-3 cleared.

(%1???????) = Any data byte with bit 7 set.

(%0??????1) = Any data byte with bit 7 cleared and bit 0 set.

The '!' inversion can still be used:

!(%??????00) = Matches any data byte ending to %10, %11, %01 but not %00.

To match a single data byte with more than one value, separate the values with comma ',':

(0, 1, 100, 200, 254) : Matches a data byte whose value is 0, 1, 100, 200 or 254.

Invert the value group match with '!'. Value wildcard '?' is also allowed.

Example:

!(1, 2, 3) : Match any data byte other than 1, 2 or 3.

!($?f, $f?) : Don't match data bytes with bits 0-3 set to 1, or data bytes that have bits 7-4 set.